

# Shake, Rattle, and Roll

## Los Alamos scientists analyze North Korea's recent "hydrogen bomb" test to determine the details—location, yield, and type—of the explosion.

Around 10 a.m. Pyongyang Time on Wednesday, January 6, 2016, seismic analysts around the world picked up something unusual—a 5.1-magnitude seismic event in the northeast corner of North Korea. Earthquakes of this size aren't common on the Korean Peninsula, which likely meant the violent shaking was caused by something else: an explosion.

Enter Los Alamos National Laboratory.

Los Alamos isn't just in the business of developing, testing, and maintaining explosives. A significant part of the Laboratory's mission is to evaluate global seismic data to identify and locate possible nuclear explosions. For example, a country might hope its underground containment of a nuclear test goes unnoticed because the rest of the world thinks the resulting seismic event is an earthquake. In the interest of national security and global nuclear threat monitoring, Los Alamos scientists have developed the tools to differentiate between the two.

But what happens when there's no need to differentiate? What happens when a country blatantly declares it tested a nuclear

weapon? In the case of the January 6 seismic event, North Korea immediately attributed the tremors to a subterranean hydrogen bomb test. H-bombs, which use nuclear fusion to release explosive energy, are potentially more than 500 times more powerful than the atomic bombs the United States dropped on Japan during World War II.

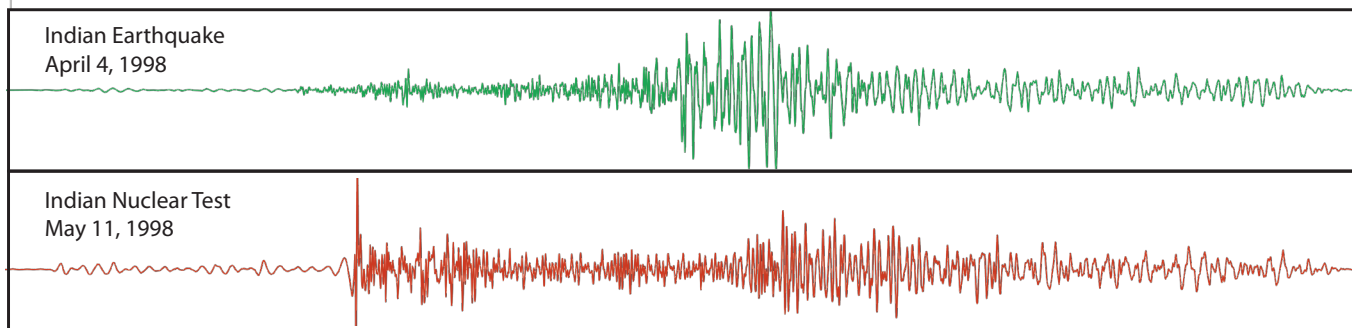
Does North Korea really have the capabilities to develop and test such a powerful weapon? Is its claim valid? Immediately upon receiving news of the explosion, Los Alamos scientists began working—and they continue to work—to determine information about the bomb tested.

Los Alamos has approximately 70 experts, organized into teams, who work full time to provide near real-time analysis and assessment of all foreign nuclear weapons programs and tests.

For example, the Ground-based Nuclear Detonation Detection (GNDD) team, comprising scientists from the Lab's Earth and Environmental Sciences division, look in the atmosphere, oceans, and underground to analyze explosions.



South Korean protesters burned placards of North Korean leader Kim Jong-Un during an anti-North Korea rally on January 7, 2016, in Seoul, South Korea. Kim Jong-Un claimed that North Korea had successfully tested a "hydrogen bomb" the previous day. (Photo: Getty Images)



*Seismograms of an Indian earthquake and an Indian nuclear test. Both were recorded at the seismic station at Nilore, Pakistan. These seismic signatures for an earthquake and an explosion are typical and can be clearly distinguished from each other.*

The GNDD team develops measurement and analysis systems for nuclear-event monitoring agencies and provides analysis in direct support of the Department of Energy's nuclear treaty verification mission (which includes the Limited Nuclear Test-Ban Treaty, Threshold Test-Ban Treaty, and the current testing moratorium under the Comprehensive Nuclear-Test-Ban Treaty).

"We are very proud of our contributions," says Terry Wallace, the Lab's Principal Associate Director for Global Security and its senior intelligence executive. "We support the nation's intelligence community in its efforts to monitor nuclear programs and verify adherence to nuclear arms control treaties."

Los Alamos has been involved in the assessment of foreign nuclear tests since August 1949, when the Soviets exploded their first nuclear weapon. "Los Alamos's analysis of atmospheric debris was an essential piece of the puzzle leading to the conclusion that the Soviets had copied the Trinity device," Wallace says.

Los Alamos also provided key instrumentation on the Vela Hotel, the very first satellite launched (in 1963) to monitor nuclear testing. The Vela satellite was an essential verification tool of the Limited Nuclear Test-Ban Treaty, which bans nuclear weapons tests in the atmosphere, space, and underwater.

"Los Alamos has been deeply involved since then with monitoring from space," Wallace says. "In fact, the latest detonation-detection satellite carrying Lab-built sensors was launched in February 2016."

In 1957, Los Alamos began studying underground nuclear tests at the Nevada Test Site—which totaled more than 800 by the last test in 1992. Understanding these seismic events ensured test-site safety and required a detailed understanding of geology and the ability to predict subsurface reactions to the explosive shock of a nuclear blast.

"Starting with the Trinity Test, I have looked at the seismographs and other geophysical recordings of *all* nuclear tests except for four or five for which data is not available," Wallace says. "This includes U.S., Soviet, Chinese, British, French, Indian, Pakistani, and North Korean tests, as well as the Vela Incident in the Indian Ocean in 1979, which is without country attribution."

Los Alamos is now the world's leader in underground test diagnostics, nuclear explosion monitoring, and nuclear weapon test treaty verification.

North Korea, of course, often doesn't adhere to treaties, but the country has violated multiple United Nations Security Council resolutions. Determining what the North Koreans are blowing up is a matter of global security—which is why Los Alamos is involved.

In the case of the January 6 test, Los Alamos seismologists began calculating the event location and yield by using data from seismic stations around the globe. Using techniques they've developed to study nuclear (and conventional explosives) tests, Lab scientists analyze data as they receive them to develop a more complete understanding of the nature of the explosion.

"We have developed seismic expertise, and we apply it effectively to understand and monitor nuclear testing," Wallace says. "The Laboratory is one of the remaining places where we see people devoting careers to understanding what other nations are doing in the areas of nuclear testing and technology. The situation in North Korea is illustrative of how the Laboratory is essential to keeping our nation—and the world—safe."

When it hits the fan, the government is counting on us—and we deliver." ✦

~Whitney J. Spivey